TOP3–00199

Two-Dimensional Design and Analysis Codes for Turbomachinery

Technology

Two-dimensional (2–D) design and analysis for fans, compressors, turbines, and pumps.

Technology Description

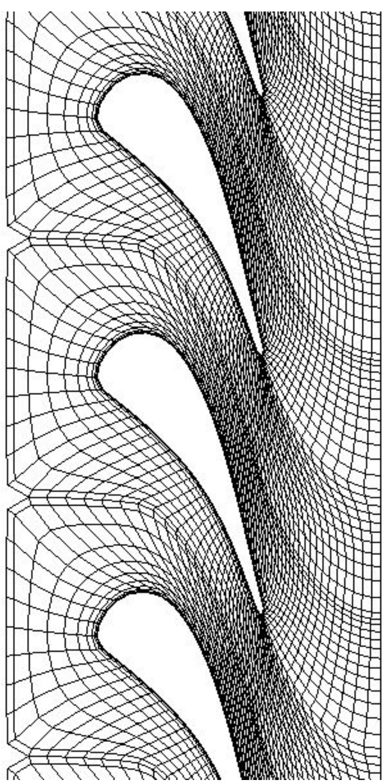
Two-dimensional codes for analyzing and designing turbomachinery blading have been developed to determine the chordwise distributions of aerothermodynamic parameters. The codes can be used to determine stage loading, blade row turning, and efficiency. They can also be used to estimate the performance, pressure loads, and preliminary flow path and blading. They were developed as design and analysis method capable of determining the performance of turbomachinery with a higher degree of fidelity.

Benefits

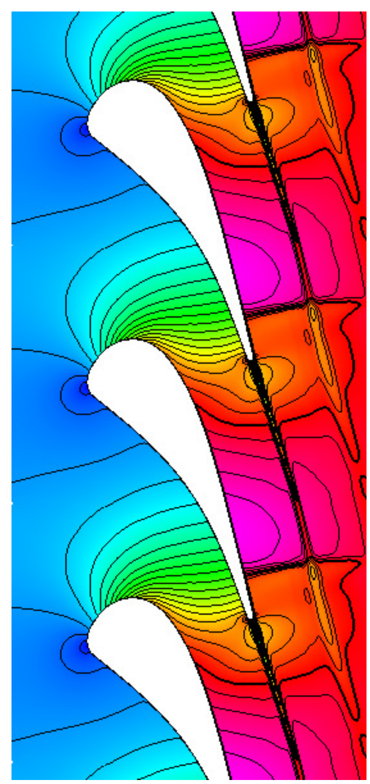
- Higher efficiencies
- Faster design cycle times
- Lower direct operating costs
- Improved reliability

Commercial Applications

- Conceptual design and analysis of compressors and turbines
- Design of axial or centrifugal turbomachinery
- Aircraft propulsion
- Auxiliary power
- Pump design and analysis



Computational grid for a turbine vane.



Computed Mach number contours around a turbine vane.

Over a 30-year period, NASA Glenn Research Center has conducted substantial turbomachinery research, which served as a basis for the development of 2–D codes. These codes are robust, fast computationally, and accurate. They require minimal input and are best used to compute detailed characteristics of turbomachinery components.

Options for Commercialization

The codes may be used to develop and enhance design tools for commercial application and can be acquired from our NASA Glenn Research Center Software Repository (SR) at https://www. technology.grc.nasa.gov/software.

References

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Contact

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Key Words

Fans, compressors, turbines, pumps
Compressor 2–D design/analysis tools
Computational fluid dynamics
Grid generation

Two-Dimensional Turbomachinery Analysis Codes

(a) Code descriptions

Code	Brief code description
ACD	Design of multistage axial-flow compressors
ACOD	Off-design of multistage axial-flow compressors
CCGEOM	Geometry generation code
MTSB	Meridl, Tsonic Blayer coupled analysis package for turbomachinery
GRAPE	2–D grid code used with RVCQ3D
RVCQ3D	Quasi-3–D blade-to-blade viscous turbomachinery flow solver
PCSTAGE	Multistage turbomachinery blade-to-blade flows on a surface of revolution

(b) Code descriptions

Preliminary design stage	Code characteristics	Typical trade studies	Aerothermodynamic uses
•ACD •ACOD •CCGEOM •MTSB •GRAPE •RVCQ3D •PCSTAGE	Robust; User friendly; Fast computationally; Good accuracy	Chordwise distribution of aerothermodynamic parameters; Flow path definition; Grid generation; Detailed blading	Performance prediction; Pressure loads; Design of flow path and blading

(c) Experience and time requirements

Code	Typical user experience	Typical time required to learn code	Set-up time	Typical times for an average case	Computer required	Where to obtain the code
ACD	Moderate	~2 wk	< 2 days	~seconds	PC	GRC SR
ACOD	Moderate	~2 wk	< 2 days	~seconds	PC	GRC SR
CCGEOM	Low	~1 wk	~minutes	~seconds	PC	GRC SR
MTSB	Low	~1 wk	~minutes	~seconds	PC/UNIX	GRC
GRAPE	Moderate	~1 wk	<1 day	~seconds	PC/UNIX	GRC
RVCQ3D	Moderate	~1 wk	<1 day	~minutes	PC/UNIX	GRC
PCSTAGE	Moderate	~1 wk	<1 wk	~seconds	PC/UNIX	GRC SR

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